Bottoms up

As Australian maritime engineering firm OMC International celebrates its 30th anniversary, its DUKC system is fast becoming an industry standard in under keel clearance

Melbourne-based OMC, which is celebrating its milestone 30th anniversary this year, has continued to create news headlines since the early days when, in May 1987, its Founder and Executive Director Dr Terry O'Brien AM left behind a distinguished academic career of 22 years to establish his own maritime engineering company OMC, working alone from the stables at the rear of the family's Melbourne home.

Fast forward 30 years and OMC has just moved again to nearby larger headquarters to accommodate its growing workforce of nearly 50 employees, and also allow for postgraduate students and short stay collaborative visits with global maritime partners.

OMC's customised DUKC systems are now operational in some of the largest bulk, container and multi-cargo ports in the world, including the Pilbara iron ore ports in north Western Australia (beneficiaries include BHP Billiton and Rio Tinto) and in some of the world's most important waterways, including the ecologically sensitive waters of Torres Strait (which is a vital shipping route for the Asia-Pacific region) and also in Canada's St Lawrence River (one of the world's busiest inland waterways) from Montreal to Quebec City.

DUKC innovator Dr O'Brien, who is recognised as the world expert on Under Keel Clearance (UKC) management, said his vision still remains to see his Australian company's flagship product DUKC become an industry standard for safe and efficient management of UKC, including risk mitigation.

"We are well on our way to achieving this but there is still more work to do," Dr O'Brien says. "We must keep re-educating ports that the necessarily conservative Static rules may not always predict a circumstance when a grounding could occur in their approach channel. Regulators can presume, sometimes incorrectly, that existing practices are safe because no incidents have previously occurred.

"A real turning point in these attitudes was achieved when, in 2004, New Zealand's Marsden Point became the first port to have DUKC installed purely on safety grounds. This followed the grounding of two post-Panamax tankers within three months of each other in 2003 in the approach channel (leading to New Zealand's only oil refinery) in Whangarei."

Dr O'Brien said Marsden Point had been operating under Static rule without incident during the 30 years before the two groundings. It was later shown that a DUKC system would have advised that these sailings not take place on those days due to inadequate UKC.

There are still about 90 percent of ports worldwide which follow Static rule for their approach channels. "The biggest drawback with static rules is that a ship's actual clearance of the seabed is so reliant on the environmental conditions," Dr O'Brien says. "They are a blunt compromise, and for safety reasons need to be derived for the worst case scenario. And they cannot predict when a grounding could occur with a change in weather, for example. OMC's historical records show approximately 95 percent of ship transits are conservative, 4 percent marginal and 1 percent potentially unsafe. Unfortunately, ports don't know when that 1 percent could eventuate."

Dr O'Brien emphasises that DUKC is always safer than static UKC rules because the real-time technology also considers the dynamic variables such as tides, waves and currents – as well as actual ship size - in the UKC decision making. "DUKC takes the guesswork out of vertical navigation, which is what you can't see under the water. You are dealing with centimetres, not metres, in accuracy of clearance which is why DUKC has to be, and is, so accurate," he says.

"Our technology is the only UKC management system in the world that has taken large ships deeper than Static rules. More than 160,000 UKC critical ships have sailed

under DUKC advice without a single incident and we are very confident our unblemished 24-year track record of safe sailings will continue, along with our evolving cutting-edge technology."

THE EARLY DAYS

So why did Dr O'Brien, a father of six, leave the security of academia in 1987 to set up his own maritime engineering company at the age of 52?

During his postgraduate study years on the behaviour of cable structures, as in suspension bridges, Dr O'Brien became intrigued by waves, currents and the motions of large ships and the challenges of creating a numerical method of modelling them. The turning point came when Dr O'Brien, who was lecturing at Melbourne University, was contacted by the then British Phosphate Commissioners to work on solutions for mooring the large phosphate ships in Nauru's particularly deep port (in the Pacific Ocean north of the Solomon Islands) and also for Christmas Island (2600km north west of Perth).

Realising there could be a niche business market, he left academia to further refine these solutions and eventually develop his innovative Simulation Package for Motion of Ships (SPMS). He established OMC to commercialise his SPMS as the core engine of his first DUKC system as it is still today.

This first system became operational at the coal export port of Hay Point, Queensland in March 1993 and delivered economic benefits of more than 30cm extra draft compared to the existing Static UKC rule for most sailings. During the following years of incremental system development and testing, these maximum drafts continued to increase cargo loads in favourable swell and tide conditions, leading to sailings more than 1m deeper than previously possible. The success of this Australian innovation has led to OMC now monitoring and supporting operational DUKC systems at 16 Australian ports and through Torres Strait (for the Australian Maritime Safety Authority), at three major ports in New Zealand , as well as at important ports in Europe and North America.

On average, DUKC systems support the sailing of one ship per hour somewhere in the world. In particular, it is estimated that 97 percent of Australia's iron ore exports (approximately 800m tonnes annually) and 80 percent of coal exports (approximately 270m tonnes annually) sail from Australian ports with loading drafts and sailing times determined by DUKC advice. During the 24 years of DUKC sailings, no incidents have occurred as a result of DUKC advice, but many occasions have occurred where DUKC advice has been used to avert a major grounding disaster or potential channel blockage due to ship engine or steering failure.

For example, in 2008, the then named Port Hedland Port Authority (PHPA) and OMC used DUKC technology to help a fully loaded bulk carrier safely transit the main channel once it had been re-floated after being grounded at Port Hedland. The re-floating of the Iron King, which ran aground on the side of the shipping channel as a result of a steering malfunction, is the first time in the world that the capabilities of DUKC technology have been used in a crisis situation to validate the opportunity to safely transit the channel outside any standard sailing window.

This incident showcased the emergency response capability of DUKC with the power to minimise damage and delays. The three-hour transit to deep water, assisted by eight tugs, was safely completed on the next high tide under DUKC advice. From some 3,000km away in Melbourne, OMC helped PHPA unblock Australia's largest iron ore port in minimum time, avoiding massive cost delays to iron ore exports from Port Hedland.

KEY LOGISTICS CHAIN PLAYER

Since the first customised DUKC system was installed in 1993, the OMC team has over the years undertaken several ship motion validation campaigns and extensive wave modelling and transformation studies as well as further developing the functionality of DUKC technology, including the latest DUKC Series 5.

"Web-enabling DUKC makes our technology more accessible and flexible," Dr O'Brien says. "As the functionality of DUKC has developed to meet different user needs, and as its application has evolved over the years from a long-term planning tool through to real-time monitoring during the actual transit, OMC has moved further into the logistics chain."

The DUKC system has progressively transitioned from a stand-alone application running on a single personal computer, to a complete server-based web-enabled system. DUKC Series 5 is able to interface with other port information and VTS systems, and to be accessed by users at desktop computers, on mobile devices, and even overlaid on the navigational charts on pilot PPU units while in use on ships' bridges.

Under the strong leadership of maritime engineers Dr O'Brien and his son Peter O'Brien, who manages the company's day-to-day operations as CEO, OMC's R&D Department has developed new products including the OMC iHeave instrument for measuring ship motions in extreme conditions and a new tool for modelling port capacity. This tool is an optional stand-alone extra capability to DUKC Series 5. DPCM (Dynamic Port Capacity Model) enables more efficient use of existing infrastructure and facilities rather than taking on the capital expense of building new facilities or harbours. It was first developed to enable the identification of additional capacity available at Port Hedland. DPCM assists Port Hedland and its users to maximise throughput from the Inner Harbour for a fraction of the cost (<10 percent) that would have been required from a $20bn Outer Harbour development.

DUKC IMPROVES THROUGHPUT CAPACITY

OMC's maritime technology, which won the 2015 IBJ 'Safety in Bulk Handling' (Marine) Award, also continues to help deliver tonnage records at the world's largest bulk export port of Port Hedland, one of the Pilbara ports in Western Australia.

In a joint effort with Pilbara Ports Authority (PPA), OMC's technology helped enable the largest ever iron ore shipment to leave Port Hedland at a record sailing draft of 19.95 metres in the morning on March 1 this year. Under DUKC advice, a record 270,006 tonnes of iron ore left the port on the Fortescue Metals Group loaded ship HL Tubarao.

Last year, a million tonnes on a single tide was achieved a record number of 60 times, a million tonnes on a tide milestone was achieved with a record 1,022,051 tonnage on five capsize ships in April last year, there was a monthly throughput record of 42.2m tonnes last June and, also under DUKC advice, a new 24-hour record was achieved at Port Hedland with 2,174,533 tonnes on 12 ships on 20 June 2016.

OMC also continues to work closely with PPA to optimise clearance depths and make the most of the highest part of the tide, including the opening and closing shoulders, to send out as many of the bigger iron ore carriers as possible. Remarkably, in 2015 a record eight ships sailed for the first time on the one tide under DUKC advice from Port Hedland.

Meanwhile, at the smaller regional Australian bulk port of Geelong, the Victorian Regional Channels Authority (VRCA) adopted DUKC in 2015 as a way of admitting larger ships with more cargo, without requiring any changes to the channel infrastructure. In the right circumstances, ships may be allowed up to 12 metres draft and that means a cargo uplift of 1,350 to 3,000 tonnes per ship.

LOOKING FORWARD

Due to OMC's unblemished safety track record of pioneering the development, validation and operation of UKCM systems (DUKC), OMC has been invited to participate as the expert contributor in the current IHO s-100 Under Keel Clearance Management Information Project Team (UKCMPT) to develop an IHO S-129 based product specification for Under Keel Clearance Management (UKCM) information to enable the outputs of UKCM services to be displayed for users (IHO, 2015). This means that all operators of DUKC Series 5 systems are assured of providing standardised outputs for the various ECDIS and PPU manufacturers to use in their DUKC display. This Project Team comprises a number of IHO Member States including Sweden, France, Korea, USA, Russia, Finland, UK and The Netherlands and is chaired by a representative from the Australian Maritime Safety Authority (AMSA). This work is expected to be completed in 2018.

Dr O'Brien said OMC will also continue its push into new markets, particularly in the bulk ports of South America and India where there is huge potential for DUKC to increase productivity whilst decreasing the risk of grounding that the larger bulk ships may present. He said a challenge for many South American ports is the limited depths in the access channels as well as coastlines exposed to swells that can generate significant wave induced ship motions.

Looking ahead, Dr O'Brien said that as other companies start to enter the niche real-time UKC market and make claims that they can deliver reliable and valid risk management, it is crucial that government and maritime safety authorities recognise that they should install the safest UKC management system which is the proven one with significant long-term validity (track record of safe sailings with no groundings).

As OMC celebrates its 30th anniversary this year, Dr O'Brien says he is satisfied that OMC's DUKC has caused a paradigm shift in UKC management from static to dynamic (real-time) analyses of UKC requirements.

"I was always convinced my 'good idea' could evolve into a working DUKC system and it has been very satisfying to witness our technology move from academic theory into world's best practice since I established OMC. Our mission is to see DUKC become, in my lifetime, the industry standard in managing UKC."

In the Queen's Birthday Honours List in June 2015, Dr O'Brien was appointed a Member (AM) of the Order of Australia and in November 2014, Dr O'Brien was inducted into the Australian Maritime Hall of Fame ■